

CHAPTER C5

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C5.00 Introduction

This chapter is divided into four sections:

- Section I: Unpaved Shoulders
- Section II: Fences
- Section III: Drainage and Miscellaneous Facilities
- Section IV: Other Roadside Appurtenances

Some of the topics included in this chapter are discussed elsewhere in this manual. For example, Section I builds on the information included in Chapters A and B. Where appropriate, there will be references to other chapters.

Section I: Unpaved Shoulders**C5.01 General**

Unpaved shoulders are that portion of the right-of-way bordering the traveled way and may be constructed either of native or imported material. Unpaved shoulders, may either be adjacent to inside or outside lanes, and provide the same function as paved shoulders. Unpaved shoulders may either be part of the original design of the highway or may have come into existence through usage.

Shoulders should slope away from the pavement at a 5 percent gradient, except on the outside of super-elevated curves or other special sections. Replace native material shoulders with imported borrow material where maintaining lateral support of pavement edges is a recurring problem.

Where native material is unsatisfactory and is being replaced, refer to Caltrans Standard Specifications Section 26 for shoulder backing material.

C5.02 Policy**(A) Type and Frequency of Maintenance**

The maintenance measures to be taken and the frequency of their use should largely be determined by the amount of traffic, general pavement condition, time of year, and the structural materials. Diked sections of shoulders require less frequent unpaved shoulder maintenance.

(B) Lateral Support

Lateral support of the pavement edge is an important maintenance consideration for protection of pavement integrity. When the support has diminished to approximately one-half the pavement thickness it should be scheduled for repair. Loss of lateral support is more critical for narrow paved shoulders than for wider shoulders due to distribution of loads relative to the edge of the pavement.

(C) Unsurfaced Areas

The above requirements for lateral support also apply to unsurfaced areas abutting the traveled way or paved shoulders. In addition, these unsurfaced areas should be relatively free of ruts and properly sloped. This ensures adequate drainage and provides room for disabled vehicles.

Shoulder blading is not a satisfactory method of vegetation control. Excessive blading can cause undesirable air and water quality problems.

(D) Safety Considerations

Shoulder operations should be conducted only on one side of the highway at a time. Refer to the appropriate Maintenance Codes of Safe Operating Practices.

(E) Need for Drainage

Drainage should be maintained to eliminate ponding near the edge of shoulder.

Section II: Fences

C5.03 Policy

State owned fences are provided to control access and prevent indiscriminate crossing of medians or ramps by vehicles or pedestrians.

State owned fences should be maintained in condition to serve their intended purposes.

State owned fences should be repaired when they are damaged to the extent that the physical barrier effect is lost or severely reduced. Owners of private property fences should be promptly notified when their fences are in need of repair in order to protect the highway user.

In case of damage that destroys the barrier effect of private fences or walls controlling State owned access, take action to restore the barrier effect. The property owner should be notified promptly of the damage and encouraged to make permanent repairs.

C5.04 General

Fences are divided into three categories:

(A) Freeway Fences and Right-of-Way Fences

Freeway fences and right-of-way fences are State owned and act as physical barriers to ensure integrity of access lines or right-of-way lines. As a secondary function these fences may act as a property fence. All freeway and right-of-way fences are placed either on the access line or immediately adjacent to the right-of-way line.

(B) Property Fences

These are privately owned fences outside the right-of-way that serve the abutting property owners' needs. Although they are the property of the abutting owner such fences may serve access control purposes. The State provides property fences only as a right-of-way consideration and does not maintain them.

(C) Median Fences

Median fences prevent indiscriminate crossings of the median by vehicles or pedestrians.

C5.05 Types of Fence

The following are the standard fences used by Caltrans Maintenance:

- (A) Type BW: Five lines of barbed wire on either wood or metal posts.
- (B) Type WM: Wire Mesh with three lines of barbed wire at the top, on wood or metal posts.
- (C) Type CL4: Chain Link fencing 48 inches (1.22 meters) high on metal posts.
- (D) Type CL6: Chain Link fencing 72 inches (1.83 meters) high on metal posts.

Type BW or WM fencing are normally used in rural areas. However, either BW or WM fencing may be placed in urban areas where natural barriers or other conditions are such that this fencing will afford the same access protection as chain link fencing.

Chain Link Fences (Type CL) are generally used in urban or developed areas. Chain link fences along the right-of-way line and in the outer separation shall be 6 feet (1.83 meters) high.

Exceptions to the 6 foot (1.83 meters) height will be allowed along the right-of-way where isolated improvements exist and a lower fence will be in keeping with the height of adjacent property fences. At these locations, the 4 foot (1.22 meters) chain link fence may be installed.

When required, a 4 foot (1.22 meters) high chain link fence, raised 6 inches (.152 meters) off the ground may be used in a median.

C5.06 Maintenance of Fences

State owned highway fences shall be maintained by the Department. Property fences are maintained by the adjoining owner. It may be necessary to check the superintendent's copy of "As Built" plans, right-of-way agreements, or actually measure on the ground to establish the location and ownership of fences.

C5.07 Repairing Chain Link Fence

There is no standard mesh for chain link fencing. Mesh design varies by manufacturer. For example, a 72 inch (1.83 meters) height chain link fence from one manufacturer will have 21 1/2 vertical meshes; other manufacturers will have 22 1/2 meshes. Manufacturers also use different types of weaving. Some prefer a right-hand weave while other companies use a left-hand weave.

Chain link fencing carried in the warehouse will vary in the number of meshes and right and left hand weave, depending upon which manufacturer is awarded the purchase order. Fence material ordered from stock may not always match the existing fencing.

New fencing material may be joined or spliced with an existing fence by inserting a seven-gauge tension wire of sufficient length through the alternate meshes vertically. This method may be used in joining fencing having either right to left, right to right, or left to left mesh, or of a different number of meshes to the height.

When joining fencing having an unequal number of meshes per height it will be necessary to cut the wire in one diamond at a point where the wires will not mesh.

Section III: Drainage and Miscellaneous Facilities**C5.08 General**

This chapter covers the repair, replacement and cleaning of ditches, culverts, under drains, horizontal drains, headwalls, debris racks, bank and shore protection and miscellaneous drainage features. Also included are sections on drift removal, bench cleaning, slide removal, fill slope replacement, repairs or replacement of retaining walls, sidewalks and curbs, bins, cattle guards and other minor structures.

C5.09 Applicable Law

The following code sections apply to drainage:

- (A) Damage to Highway by Water 588 Penal Code; 725 Streets and Highway Code.
- (B) Drainage or Impounding of Water, 725 - 729 Streets and Highway Code.
- (C) Water, 725 - 727 Streets and Highway Code.

C5.10 Policy

Inspections of drainage facilities should be made annually in the fall, and during and after each major storm to determine if cleaning is required or if damage has occurred.

Refer to the Caltrans Storm Water Quality Handbook - Maintenance Staff Guide for detailed instruction regarding inspections.

C5.11 Culverts

Culverts are structures conveying water under or through embankments, with transitions and appurtenances for erosion and debris control. Culverts should be kept open and in a state of good repair.

Damage that impairs the structural integrity of the culvert should be repaired immediately.

Culverts should be cleaned of sediments when they are no longer able to function properly.

Channels should have sufficient depth and grade to ensure drainage to and from culverts, from the roadway, and from other roadside areas. Scoured areas that are a potential threat to structures should be corrected.

Drainage grates should be maintained free of debris.

C5.11.1 Record of Culvert Performance

Performance data in regard to the more important culverts should be recorded after major storms and while evidence of flood stage elevations are clearly observable. The height of drift above invert near the outlet and inlet of the culvert should be noted after the storm. The condition of the culvert should be checked as soon after the storm as possible noting abrasion, pitting, rust, rivets, spalling, exposed reinforcing, cracks, joint openings, drift and detritus in barrel. Scour and erosion should be noted at both inlets and outlets. Erosion of channel banks downstream from large culverts should be observed. Erosion and undercutting of slope protection near a culvert should be noted.

C5.11.2 Culvert Installation

Culverts shall be installed as set forth in the appropriate sections of the Standard Specifications.

Where traffic or other conditions warrant, half width construction may be permitted. If conditions do not permit open trench construction, it may be necessary to jack pipe through the embankment.

If the inverts of metal pipe installations are worn to the extent requiring repair or replacement, consider the following courses of action:

- (A) If the remainder of the barrel is in good condition the pipe may be relined with mesh reinforced concrete or asphaltic concrete. Use reinforced concrete if slope of culvert is greater than 1 percent.
- (B) Insert and seal a smaller diameter pipe inside the original pipe if hydraulic requirements permit.
- (C) If the existing culvert appears to be inadequate, replacement with large pipe should be referred to Project Development, Hydraulic Section. There are numerous problems that could involve right-of-way, increased flows, erosion, or other problems, which should be studied before a culvert is increased in size.

C5.12 Ditches and Gutters

Ditches and gutters should be inspected periodically and maintained to permit free flow. Lined ditches and gutters should be sealed or repaired to maintain structural integrity.

C5.13 Drainage Channels and Shorelines

Highway facilities are susceptible to damage from heavy flows of water and protective devices are provided for many facilities, such as riprap, slope paving, gabions, walls, vegetation or other devices. It is essential that these devices be maintained to ensure proper function. Refer to the Bank and Shore Protection section of the Highway Design Manual for further information.

Protective devices near water channels and shorelines should be checked periodically to detect conditions that may cause scour, undermining, washout, or other damage to the highway or facilities by water or wave action. Deficiencies that endanger highway facilities should be repaired promptly. Temporary repairs often are necessary until permanent repairs can be scheduled. Consult the District Hydraulics Unit for assistance with repairs that require significant effort.

Repair or correction of deficiencies not having an immediate effect on the structural integrity of highway facilities should be coordinated with routine maintenance operations. Work in channels should be coordinated with the local offices of State and Federal regulatory agencies.

C5.14 Under Drains, Horizontal Drains and Down Drains

Under drains (including underground groundwater relief systems, horizontal drains-cut slope groundwater drains, and down drains), surface drainage conduits and accompanying collector systems should be inspected once a year and cleaned or repaired as necessary to insure free flow.

Surface water should not be permitted to discharge into an under drain.

C5.15 Edge Drains

Properly installed and maintained pavement edge drains can help ensure long pavement life.

Edge drains should be inspected early in the winter season to assure that they are functioning.

This should be done during or shortly after a rainstorm to observe the flow. If a drain appears to be clogged, it may be checked with a "snake" and cleaned by water jet equipment if necessary.

Clean outs have been installed for this purpose.

C5.16 Structure Drainage Systems

Bridge drainage systems should be inspected annually prior to the rainy season, and cleaned where necessary. These systems should be observed during storms to ensure proper functioning.

C5.17 Minimum Thickness of Cover

The table below provides the minimum thickness of cover measured at the edge point required for design purposes over pipes and pipe arches. For construction purposes, a minimum cover of 6 inches (.152 meters) greater than the thickness of the structural cross section is desirable for all types of pipes.

Class "C" concrete backfill may be used for culverts where it is necessary to have less than two feet of cover below the top of a flexible pavement. A minimum of one foot (.3048 meters) of concrete backfill should be used at the sides of the culvert.

		Minimum Thickness of Cover	
Surface type	Corrugated metal pipes and pipe arches	Structural plate pipes and pipe-arches	Reinforced concrete pipes
Flexible pavements or unpaved	Diameter or span 5 2 ft. (.6096 m) minimum	Diameter or span 8 2 ft. (.6096 m) minimum	2 ft. (.6096 m) minimum
Rigid pavements	Diameter or span 5 1.2 ft. (.3658 m) minimum	Diameter or span 8 1.2 ft. (.3658 m) minimum	1 ft. (.3048 m) minimum

Figure C5-1: Minimum Thickness of Cover for Culverts

C5.18 Jacking and Boring Pipe

Concrete and corrugated metal pipe may be installed by jacking or boring through the embankment.

Usually, pipe that is 30 to 60 inches (.76 to 1.52 meters) in diameter is the size for installation by jacking. As the jacking operation progresses, material is hand excavated or sluiced from inside the pipe. Section C5.11.2 includes details for jacking corrugated metal pipe. Concrete pipe is installed in a similar manner.

Pipe smaller than 36 inches (.914 meters) in diameter may be installed in a similar manner by boring. In this case material is excavated from inside the pipe with a mechanical earth auger.

Obstructions in the fill such as boulders, rocks or utility lines may make this method impractical.

C5.19 Private Irrigation Facilities

Where cross pipes or siphons are installed for the purpose of conveying irrigation water, maintenance of the installation may be the responsibility of the abutting property owners or others. Check right-of-way contracts and encroachment permits for conditions regarding such culvert installations to determine maintenance responsibility.

C5.20 Entry Upon Private Property

Conditions may require that employees enter upon private property to maintain and repair drainage conduits or other structures or appurtenances within the State highway right-of-way.

A legal opinion on this subject states that except in cases of emergency, "Before entering upon private property to maintain or repair culverts, or other structures, or appurtenances, employees should obtain the property owner's consent whenever practical, and in no event should employees ever enter private property after an owner thereof has expressed opposition to such entry."

If entry is denied but is necessary contact the District Division Chief of Maintenance and Operations. He or she may determine that legal assistance is necessary.

Consent to enter upon private land may be obtained by a simple document such as the following:

<p>Date -----</p> <p>I hereby grant permission to the State of California and its authorized employees to enter upon only so much of my property as may be necessary to maintain and repair drainage conduits, or other structures or appurtenances, located within the highway right-of-way.</p> <p>This permission shall continue in effect until revoked by me or my successors.</p> <p>_____</p> <p>(Signature)</p>

Figure C5-2: Right of Entry Request

C5.21 Maintenance of Over Side Drains and Slope Ditches

Pipe or flume down drains, paved spillways, and slope ditches are provided to convey water from the embankment or slope.

Structures of this type should be maintained intact and in the case of metal assemblies maintained in tight contact with shoulder surfacing, side ditch lining, and dike paving. If embankment settlement occurs restore to grade and re-establish down drains or spillway, side ditch and dike.

Fill and seal cracks around inlets of down drains and seal paved spillways to prevent seepage of water into embankment areas.

C5.22 Under Drains

Under drains serve to intercept ground water before it reaches the subgrade. Perforated pipes that may be steel aluminum, plastic, galvanized corrugated metal or tile are used for this purpose.

Local conditions will determine whether the installation should be along the shoulder line or toe of slope or a herringbone system under the traveled way.

The minimum diameter of pipe to be used is 6 inches (.152 meters). Place perforated metal pipe with perforations down. Invert grade of pipe should be at least 3 feet (.914 meters) below surface. A grade of at least 0.5 percent should be used if possible; however, if this slope is unobtainable grades of 0.20 percent for laterals and 0.25 percent for mains may be established.

Refer to Standard Specifications for methods of placing pipe, filter material and grading of filter material. Stabilize soft or mucky trench bottoms by tamping in straw or add sufficient granular material to stiffen the muck.

Surface drainage should not be permitted to discharge into an under drain. Clean outlets of under drains to maintain flow of water.

C5.23 Horizontal Drains

Subsurface water is frequently a primary cause of landslides or slip outs that may close or impair the use of the road. Landslides can sometimes be prevented or controlled through installation of horizontal drains, by themselves or in combination with other treatment.

Horizontal drains consist of perforated metal pipes installed in holes drilled on a slight gradient into fill, cut or natural slopes. Perforated 2 inch (.051 meters) iron pipe is normally used for casing. It is usually necessary to provide a suitable collection system to remove the intercepted water from the area.

Horizontal drains will lose their effectiveness unless properly maintained. The drains require periodic cleaning, and the collection system must be kept in repair. The Caltrans Transportation Laboratory (Translab) can recondition horizontal drains. Translab will also perform condition surveys on request.

C5.24 Dry Fords

Stream fords may be provided on minor highways at watercourses subject to flash floods.

Culverts carry the normal flow and paved dips with cutoff walls or slope paving on either side carry the overflow. Keep culverts clean and dip surfacing intact and sealed. Repair and support undercut walls or slope paving.

C5.25 Bank and Slope Protection

C5.25.1 Bank Protection

Protective measures may be required where a stream flow or wave action endangers highway embankments or structures and even private property. Erosion may be controlled through a variety of methods, as provided in this section.

The type of protection should be chosen so as to maintain the location and natural roughness of the bank, making optimum use of local material. The velocity of flow and direction of currents are very critical factors in selecting the material.

During emergencies, rock may be deposited along the bank for erosion control. Sandbags and weighted canvas or plastic sheets may also be used. Dumping tree trunks or stumps along a bank to control erosion is not advised, since this material may float out on subsequent storms and endanger downstream bridges or structures. Planting willows along an overflow bank may aid in controlling erosion by reducing the velocity of flow, but the possibility of the willows being scoured out and becoming damaging drift should be considered.

Dikes may be constructed to direct water away from a fill or bridge abutment, but may cause erosion of private property. Dikes or other obstructions that cause abrupt change in current should be avoided.

If bank protection or stream control devices extend beyond the right-of-way, right of entry should be obtained before making repairs. See Section C5.20: Entry Upon Private Property.

C5.25.2 Rock or Stone Slope Protection

Rock or stone slope protection is flexible, easily repaired and has the ability to resist heavy impact from drift and debris. The toe should be below depth of scour. The weight of stone or rock should be based on the velocity of flow and depth of scour. Refer to Standard Specifications for size and quality and to the Bank and Shore Protection manual for design and method of placement.

Slope protection damaged or displaced should be replaced after each storm, as conditions warrant. In an emergency with damage continuing, repairs may be made with heavier unclassified rocky material.

Rock or stone that is dumped into place (Method B Placement), must be larger than rock placed by Method A which required a three point bearing placement.

C5.25.3 Grouted Rock Slope Protection

This type of protection consists of rock slope protection having voids filled with Portland concrete cement (PCC) grout to form a solid armor. It has application in areas where rock of sufficient size for ordinary rock slope protection is not economically available. Grouting not only protects the stones from the full force of high velocity water, but integrates a greater mass to resist its pressure. Grouting will usually more than double the cost per unit volume of stone. This type of protection is rigid without high strength and requires support by embankment. Prevention of undermining is important. Grout penetration should be 18 inches (.457 meters) for 1/2 ton (.4536 tonne) rock varying to 6 inches (.152 meters) for cobbles. It should not be used on slopes steeper than 1 1/2:1. The grout should be placed in voids that do not have fine material that will hinder the penetration of the grout. The depth of grout penetration is shown in Table 5, page 124, Bank and Shore Protection of the Standard Plans. Extra precaution should be observed to construct the toe of grouted slope protection below the depth of scour. A gravity cut-off wall at the toe of the slope protection may be required. The rougher the surface the better the protection serves.

C5.25.4 Paving Slope Protection

This rigid type of slope protection composed of concrete reinforced with wire mesh, is subjected to damage by undermining hydrostatic pressure and material being washed through cracks. If degrading of stream or scour expose the toe, the toe should be protected with heavy rock, grouted rock, or concrete cut-off wall.

Weep holes should be placed in the slope paving if there is a possibility of water seeping behind the paving. They may be placed by drilling a hole in the slope paving, placing rock behind the paving and grouting a section of pipe in place. If cracks develop, of sufficient size to permit the backing material to wash out, they should be sealed with concrete grout.

C5.25.5 Sacked Concrete Slope Protection

This method of protection consists of facing the embankment with sacks filled with 4-sack concrete made with stream run sand and gravel. The toe should be below anticipated scour. The strength depends on the embankment that should be well compacted. Placing of the sacks usually leaves sufficient voids so hydrostatic pressure is not built up behind the sacks.

Much hand labor is required but it is simple to construct and adaptable to almost any embankment contour. The installation must depend upon the stability of the embankment for support and should not be placed on slopes steeper than the angle of repose. 1 1/2:1 slopes are preferred but 1:1 have been used safely.

The cost is usually more than twice the cost of rock for equal protection against velocity of flow, and is used where stream gravel is available and satisfactory rock is not economical. Almost all failures of sack concrete areas result from stream water eroding the embankment material either from the bottom or the ends. A 5 foot (1.524 meters) depth below stream bed is used often where the stream bed is sandy. Cut-off studs are used at intervals and at ends. Standard plans are available.

Dry pack placement has been used with the water applied by spraying the surface. Dowels have been driven into the wet sacks in place to add extra strength.

C5.25.6 Asphalt Concrete Slope Paving

This type of protection consists of a facing of asphalt concrete, usually reinforced with wire mesh. The mixture should be dense and rich in asphalt to increase durability. It is susceptible to damage from hydrostatic pressure. It is useful in reservoirs and canal lining where water surface draw down is not rapid.

C5.25.7 Rock and Wire Mattress

This type of bank protection consists of flat mats fabricated from wire mesh such as fencing, filled with rock and well anchored. It is used where the only rock economically available is too small for rock slope protection. It is subject to damage by salt air and streams carrying gravel and stones which would erode the wire mesh. Its use is declining.

Flexible rock and wire mattress, properly anchored, may be used to protect against severe scour especially at the base of concrete slope paving or sacked concrete slope paving. If undercut, the toe of the mat tends to adjust itself to the scoured section and retards further undermining.

Economy of use is governed by availability of selected rock filling and likelihood of corrosion of the galvanized wire mesh.

C5.25.8 Retards and Permeable Jetties

Retards and permeable jetties are extensive or multiple unit structures composed of similar open forms, like piling, fencing and unit frames. Retards are placed parallel to the embankment to lessen the velocity along the embankment to prevent erosion or scour to its toe. They may be used in conjunction with armor slope protection of lighter type or to induce vegetation growth along the bank. They may be used to slow the flow on one side of the channel to effect an increase on the other side, or to slow a rebounding high velocity.

Permeable jetties are placed at an angle with the embankment to control a winding stream or to encourage deposition of bed material and growth of vegetation.

There are various types such as timber piling with wire mesh or rock-filled; timber or wire fencing; steel rail tetrahedrons, steel rail jack. Even a string of car bodies can be classed as a retard.

Pile and wire or pile and plank bank protection may be used at locations where substantial pile penetration is an advantage and can be obtained.

Jetties extending into the stream to direct the flow and to control bank erosion may be constructed of piles, earth, stones or other material.

A retard is one or more rows of piles, wire fence or other permeable type of structure placed in the stream channel at the base of and parallel to the bank. It has the effect of reducing stream velocity adjacent to the bank, thus controlling erosion and causing deposition of waterborne material between the retard and the bank. Maintenance of such structures is confined primarily to the replacement of stone fill, if used.

C5.25.9 Groins

A groin is a solid or permeable and relatively slender barrier opposing the natural flow of water to control the movement of bed material. It may be built of stone, concrete, steel or timber.

C5.25.10 Interlocking Steel Sheeting

Interlocking steel sheeting is an impermeable type of bank protection, and its use may be required where strong eddy currents are encountered.

This type of bank protection may be constructed of 12, 10 or 7 gauge steel sheets, 3 to 18 feet (.9144 to 5.49 meters) long as required. Where necessary the completed wall can be tied to a deadman in the embankment with cables secured to one or more rows of walers. Walers consist of structural shapes attached to the face of the wall by bolting or welding. Driving should be done with a heavy maul or hammer, or a pile driver of the drop or air hammer type. A steel angle, or channel shapes can be bolted or welded along the top of the wall.

C5.25.11 Air Blown Mortar

Air blown mortar, sometimes called Gunite, may be used for slope paving or ditch and channel lining. It is a mixture of Portland cement concrete (PCC) and sand, mixed dry, and pneumatically applied through a nozzle. Water is added just prior to the expulsion of the mixture from the nozzle. The dry mixture consists of one part PCC to not more than four parts of fine aggregate.

Refer to Standard Specifications, Portland Cement Concrete, for fine aggregate grading.

Keep cracks in air blown mortar slope paving filled with joint filling material. Patch the surface with a mortar mixture.

C5.25.12 Tetrahedrons

Tetrahedrons constructed of steel rails are limited to use in broad stream channels where the slight restriction effected by the tetrahedrons will not appreciably increase stream velocity, or across embayments which have developed in recent floods. This permeable type of protection tends to reduce stream velocity adjacent to the embankment and promotes deposition of material.

C5.25.13 Jackstraws

Jackstraws, usually constructed of railroad rails, are not recommended for general use, but may be resorted to in emergency as a control measure, at critical locations. Heavy junk such as old car bodies may serve the same purpose.

C5.25.14 Fence Type Protection

Wire mesh fences, constructed either with steel rail or pipe may be used to confine streams of moderate flow within definite channels or to protect embankment slopes, which are subject to erosion by high water. This type of protection consists of a single or double line of posts and wire mesh, between which is formed a wire mesh basket filled with brush and rocks. Fences should be well anchored to prevent overturning.

As the wire basket settles due to scouring action or compaction of filler material, additional brush and rock may be added to maintain the effectiveness of the structure.

See Section II of this Chapter: Fences for details of rail and wire fence construction.

C5.25.15 Control of Ditch Erosion

Excessive erosion in drainage ditches may be controlled by applying asphalt concrete or premix material, loose cobbles or grouting rock, and by constructing check dams. Sausage rolls of chicken wire filled with small rock are effective.

Construct additional cross drains as required. Where water ponds on shoulder areas, provide additional drainage by cutting dikes and installing over side drains. Prevent slope erosion by paving outlet ditches on flat slopes; or by using pipes or flumes on steep slopes.

Section IV: Other Roadside Appurtenances**C5.26 General**

This section discusses appurtenances located throughout roadsides. It does not include electrical roadside appurtenances, nor those associated with pedestrians.

C5.27 Benches

Bench areas in slope areas should be physically inspected as needed. Accessible benches should be cleaned when drainage is operationally impaired.

C5.28 Curbs and Curbed Islands

These facilities provide one or more of the following functions: Control drainage, separate vehicles from pedestrians, channelize traffic, or provide pedestrian refuge.

When curbs fail to perform their function due to settlement, heave, or damage, they should be repaired or replaced.

C5.29 Sidewalks

Periodic inspections should be made of sidewalks, both in unincorporated area and in cities to ensure that they are safe for users. Breaks, holes, or other damage should be repaired promptly.

Significant variation in height between adjoining slabs in a sidewalk should be corrected.

Sidewalk repairs within cities should be handled by city forces where a maintenance agreement exists. Where unsafe conditions are found to exist, cities should be requested to have repairs made promptly.

Curbs that are attached to sidewalks should be maintained approximately to the level of the sidewalks.

C5.30 Curb and Sidewalk Repair

The responsibility for repairing curbs and sidewalks within the right-of-way will, in general, be assumed by the State.

The exceptions to this are the placement of a sidewalk under encroachment permit, where the permittee will maintain the sidewalk; and where local agencies have requested nonstandard items, in which case, they should be responsible for maintenance costs.

In the event the permittee, upon proper notification, refuses to repair a hazardous sidewalk condition, the duty falls upon the State to repair such condition.

Where a substantial expenditure is required to repair a dangerous or defective condition in a sidewalk, a claim shall be made against the permittee who is obligated to make repairs.

In incorporated cities, the responsibility for maintenance of curbs and sidewalks may be delegated to the city. In such cases, the city should exercise reasonable diligence in the performance.

C5.31 Debris Barriers

Debris barriers such as fencing, walls, cribs, and dikes are installed to reduce the possibility of falling rocks and other material from reaching the traveled way.

Surveillance of debris barriers should be made as needed to ensure functional integrity.

Material accumulated behind debris barriers should be removed when effectiveness of the barrier is impaired.

C5.32 Retaining Walls and Cribs

Retaining walls may be either plain or reinforced concrete, metal, concrete or timber cribs or sacked concrete.

Check and repair as necessary all rubble or masonry walls. Concrete or mortar shall conform to Standard Specifications. Keep weep holes in walls open. Prevent erosion at base of walls.

Peel bark from logs, except redwood or cedar, used as cribbing.

Keep timbers free of weeds and fire hazards. Small trees growing between concrete crib members should be removed.

Concrete in sacks stacked one upon another has proven satisfactory for low retaining walls and for paving slopes.

A periodic check should be made on all timber cribs, and bulkheads, for signs of failure. Make such repairs as conditions warrant.

C5.33 Graffiti Removal

Offensive or discriminatory graffiti should be removed as soon as possible after discovery.

Removal of other graffiti should be scheduled on a regular basis as are other maintenance activities. In scheduling removal of inoffensive graffiti that is within our right-of-way and visible, the highway facility should be given top priority over that visible from cross streets, adjacent property, frontage roads, etc.

Maintenance management should be alert for efficient and cost effective ways of handling this problem.

Graffiti removal may be scheduled during peak hour traffic when work on the traveled way is not possible. It is also a good activity for the use of those involved in the law violator program.

Response to complaints concerning graffiti should be made on a timely basis taking into consideration other work priorities.

District and Headquarters personnel making field reviews should be alert for problem areas and report them as part of their review reports.

Refer to Chapter D1 of this Manual: Litter, Debris and Graffiti.

C5.34 Disposal of Waste Material

In some cases, it may be appropriate to use suitable waste materials to reinforce pavement edges or widen shoulders and parking areas.

To the extent practicable, waste materials shall be hauled to disposal sites that have been approved for that purpose through accepted procedures. In areas where haul distances to disposal sites are unreasonable, earthen waste material may be disposed of along the right-of-way at locations.

In all cases, these disposal locations must be agreed upon by concerned agencies such as Fish and Game, U.S. Forest Service, Regional Water Quality Control Board and the local enforcement agency responsible for controlling disposal of solid waste. The District Environmental Branch Chief should be consulted for liaison with these agencies. In identifying and using such locations, the prime considerations should be that the material to be disposed of is essentially inert. The following are primary considerations in selecting right-of-way disposal sites:

- (A) Petroleum-based material such as asphalt pavement shall not be placed in stream beds;
- (B) The sites should not be objectionable from the esthetic standpoint; and
- (C) The waste material shall not go directly into streams or stream channels.

Before using any disposal areas, be certain the water quality control boards are made aware of the locations and concur in their use. The instructions found in Chapter 1 of this Manual, Section 1.23: Protection of Sensitive Environmental Resources, apply to disposal of waste material. When it is not practicable to stockpile or haul material during an emergency, it may be disposed of over the side of the roadbed at the nearest convenient location. Examples of such emergencies are slides that have caused road closures, or when materials on the roadbed are creating traffic hazards. The disposal location must not create further hazards, or cause problems greater than the existing situation. Only the minimum quantities necessary to open the road and make it safe may be disposed of in this manner.

In the case of large slides (many thousands of yards/meters), Caltrans may push over the side only the amount of material required to use trucks or hauling equipment to pioneer the slide. Only the minimum quantities necessary to open the road and make it safe may be disposed of in this manner. Remaining material should be stockpiled nearby for temporary storage if necessary and then later hauled to an approved disposal site.

Any emergency disposal of materials into a water body must be reported to the California Department of Fish and Game within fourteen days.

C5.35 Bicycle Facilities

Separated bicycle paths and shoulder areas where bicycle travel is allowed shall be maintained at a level to provide safe and convenient bicycle travel. Maintenance of bicycle facilities shall include but not be limited to sweeping, patching, striping and other functions necessary to maintain at the above levels. These are all maintained in conjunction with the traveled way.

Bicycle paths (separated from motor vehicle traveled ways) are repaired and maintained in the same way as flexible roadbed. They are inspected for loose material and swept accordingly. A small parking lot type sweeper is ideal for bike path maintenance.

In addition to using separated bicycle paths, bicyclists are permitted to travel on State highways except certain prohibited sections of freeway. The needs of bicyclists should be taken into account, to ensure that highway improvements and maintenance operations are not detrimental to safe and convenient bicycling.

See Chapter A of this Manual, Section A.22: Bicycle Paths for more detailed information.

Section 39000 of the Streets and Highways Code pertains to bicycles.



Figure C5.-3: Half-ton RSP, 2-Sha-5, Postmile 50.1. Courtesy, Kathy Coots, Maintenance Supervisor, 2-98.



Figure C5-4: Half-ton RSP with Weep Pipe, District 10, East Fork Carson River, Unknown Route and Postmile. Courtesy, Jim Racin, ESC, Maintenance and Investigation Office, 1-97.



Figure C5-5: Grouted RSP, District 10, East Fork Carson River, Unknown Route and Postmile. Courtesy, Jim Racin, ESC, Maintenance and Investigation Office, 1-97.

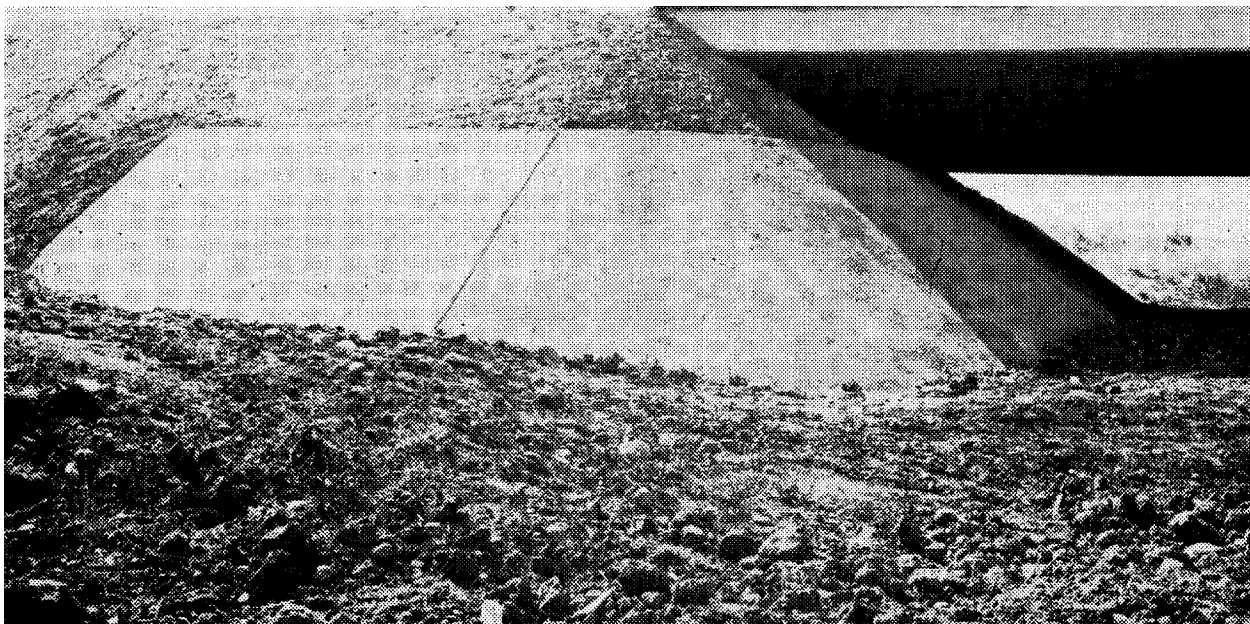


Figure C5-6: Paved Slope Protection, Unknown Location. Courtesy, Steve Ng, ESC, Maintenance and Investigation Office, 4-98.



Figure C5-7: Sacked Concrete Slope Protection, District 2, Trinity County, Unknown Route and Postmile. Courtesy, Steve Ng, ESC, Maintenance and Investigation Office, 4-98.



Figure C5-8: Rock filled double pipe and wire fence, Dry Creek, Lake County, Unknown Route and Postmile. Courtesy, Steve Hg, ESC, Maintenance and Investigation Office, 4-98.

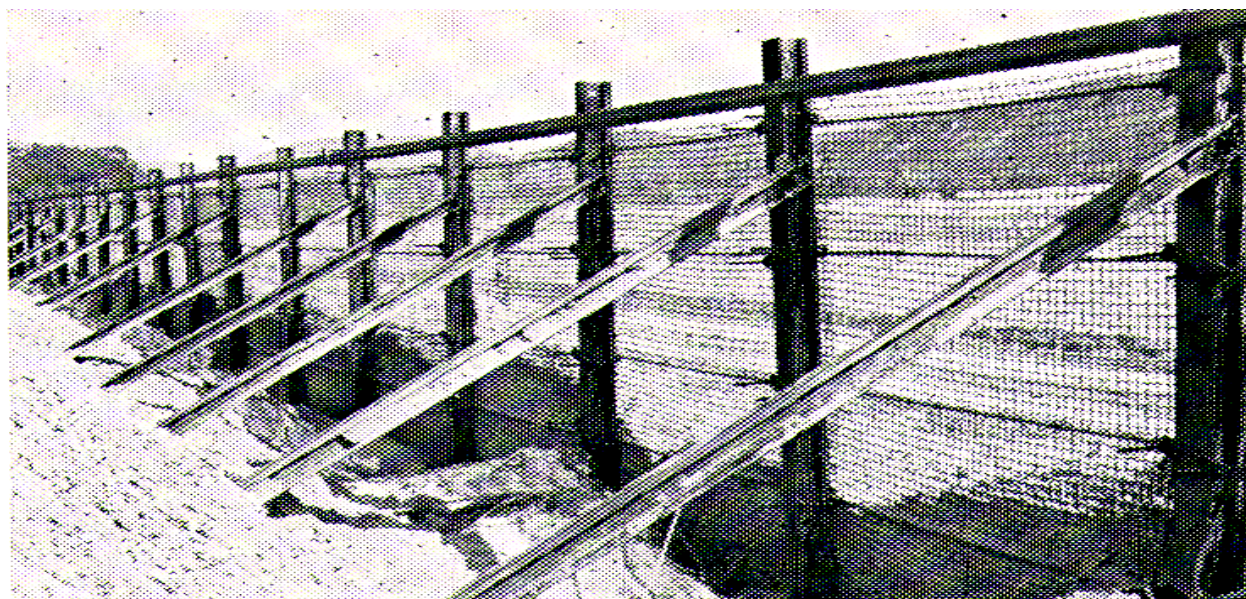


Figure C5-9: Single Row Rail Pile Retard, District 7, Ventura County, Unknown Route and Postmile. Courtesy Steve Ng, ESC, Maintenance and Investigations Office, 4-98.

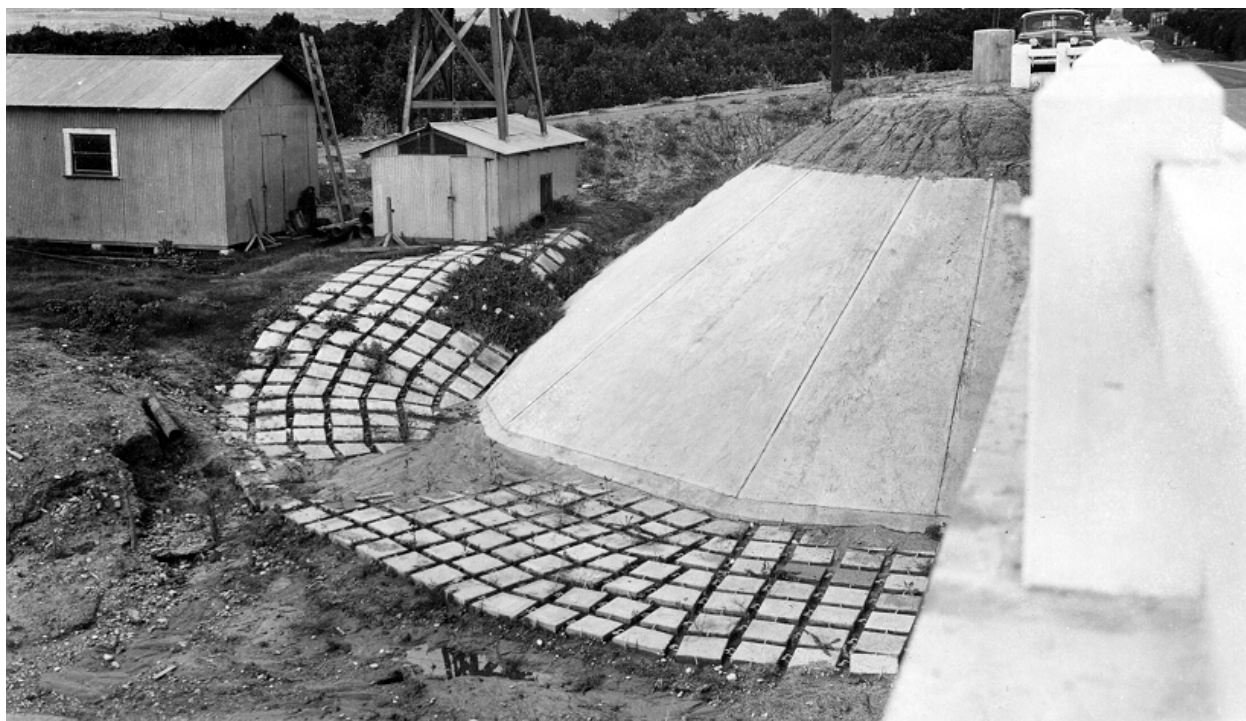


Figure C5-10: PCC Mattress and Concrete Paved Slope Protection, Unknown Location. Courtesy Steve Ng, ESC, Maintenance and Investigations Office, 4-98.



Figure C5-11: Permeable Pile Retard, Humbolt County, Eel River, Unknown Route and Postmile. Courtesy, Steve Ng, ESC, Maintenance and Investigations Office, Circa 1924.



Figure C5-12: Log Crib Impermeable Jetty, Triangular, Humboldt County, Eel River, Unknown Route and Postmile. Courtesy, Steve Ng, ESC, Maintenance and Investigations Office, 4-98.

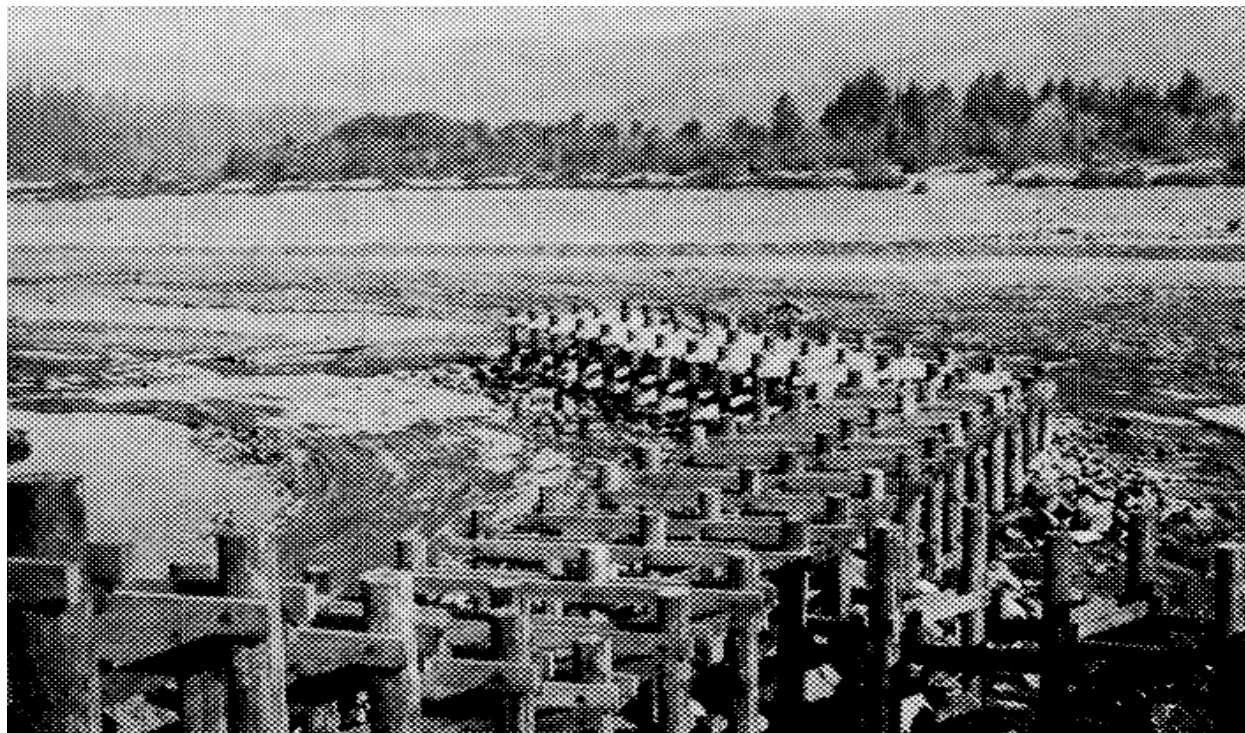


Figure C5-13: Timber Pile Jetty, Permeable, Humboldt County, Eel River, Unknown Route and Postmile. Courtesy, Steve Ng, ESC, Maintenance and Investigations Office, 4-98.



Figure C5-14: Steel Rail Tetrahedon Retard, District 5, Salinas River, Unknown Route and Postmile. Courtesy, Steve Ng, ESC, Maintenance and Investigations Office, 4-98.



Figure C5-15: Double Row of Fence, rock Filled, District 5, San Benito River, Unknown Route and Postmile. Courtesy, Steve Ng, ESC, Maintenance and Investigations Office, 4-98.